

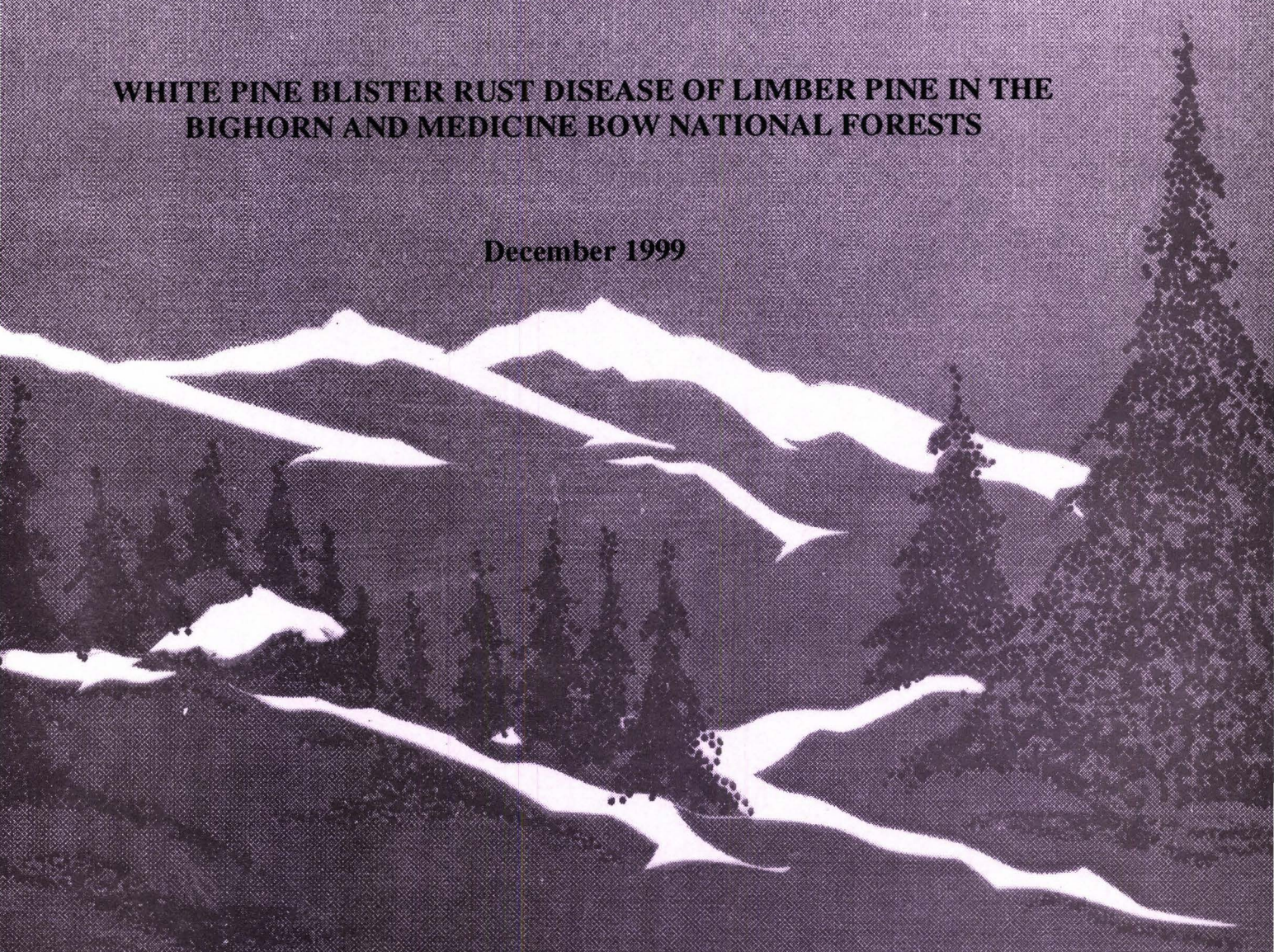
SB
761
.47
R6
NO.00-02

Forest Health Management

Biological Evaluation
R2-00-02

**WHITE PINE BLISTER RUST DISEASE OF LIMBER PINE IN THE
BIGHORN AND MEDICINE BOW NATIONAL FORESTS**

December 1999



United States
Department of
Agriculture

Renewable Resources
Forest Health Management

Forest Service
Rocky Mountain Region
Denver, Colorado



The United States Department of Agriculture (USDA) prohibits discrimination on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, and marital status. (Not all basis apply to all programs). Persons with disabilities who require alternative means for communication of program information (Braille, large print, audio tape, etc.) should contact the USDA Office of Communications at 202 / 720-2791.

To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, DC 20250, or call 800 / 245-6340 (Voice), or 202 / 720-1127 (TDD). USDA is an equal employment opportunity employer.

Biological Evaluation
R2-00-02

**WHITE PINE BLISTER RUST DISEASE OF LIMBER PINE IN THE
BIGHORN AND MEDICINE BOW NATIONAL FORESTS**

December 1999

Prepared by: 
Jeri Lyn Harris
Plant Pathologist
Rapid City Service Center

Approved by: 
Kurt K. Allen
Rapid City Service Center Leader
R2, Forest Health Management

Approved by: 
Robert D. Averill
Group Leader
R2, Forest Health Management

Renewable Resources
USDA Forest Service
Rocky Mountain Region
740 Simms Street
Golden, CO 80401

National ES Library
USDA Forest Service

JUL 15 2011

240 W Prospect Rd
Fort Collins CO 80526

Biological Evaluation R2-00-02, WHITE PINE BLISTER RUST DISEASE OF LIMBER PINE IN THE BIGHORN AND MEDICINE BOW NATIONAL FORESTS

Abstract

White pine blister rust disease has been found at low to moderate infection levels in several limber pine stands of the Bighorn and Medicine Bow National Forests. Limber pine is the main vegetative component for many harsh sites in the Rocky Mountains. White pine blister rust disease may be contributing to a noticeable decline in limber pine stands and causing deforestation of these sites. Low incidences of the disease were found during limber pine surveys in the 1960's. Forest Health Management recently surveyed several more stands to see if the disease was still present at low incidence levels on the Bighorn and Medicine Bow National Forests. Permanent plots for long term monitoring of the disease were established on some of these sites to evaluate changes in infection and severity levels. Low to moderate incidence levels of white pine blister rust disease were found on the Bighorn and Medicine Bow National Forests. Sites in the northern part of the Bighorn National Forest had very little rust infection. The disease occurred on scattered trees with only a few containing girdling stem cankers. However, the sites in Ten Sleep Canyon of the Bighorn National Forest had a 66% incidence level of the disease on the limber pine. The Pole Mountain area of the Medicine Bow National Forest also had a moderate level of the disease with 50% of the limber pine infected. Forest Health Management will continue to monitor these permanent plots for changes in the incidence and severity levels of the rust on these sites. If infection levels become unacceptable to forest managers then suppression efforts could be used to reduce the disease incidence in these areas.

Introduction

White pine blister rust disease occurs in several stands of limber pine (*Pinus flexilis*) on the Bighorn and Medicine Bow National Forests (Brown 1967, Brown 1978). This disease, caused by an introduced fungus, *Cronartium ribicola*, severely impacts white pines throughout many Western forests (Hoff *et al.* 1992). White pine blister rust disease may be contributing to a noticeable decline in many limber pine stands in the Rocky Mountains (Taylor and Schwandt 1998).

Limber pine is a white pine that is very susceptible to this rust disease (Hoff *et al.* 1980). Although limber pine has not been a marketable timber species, it is a main vegetative component for many harsh sites in the Rocky Mountains. Limber pine often grows in pure stands on droughty, windy sites where often no other tree, and sometimes no other vegetation, can grow (Kendall and Schirokauer 1997). White pine blister rust disease may be causing tree mortality and deforestation of these sites.

C. ribicola infects white pines when the fungal spores are blown from the alternate host plants, *Ribes* spp., and penetrate pine needles. The fungus grows into the pine shoots, and then develops branch cankers that girdle and kill branches. If the branch cankers are within close proximity to the main stem of the tree, then the cankers further expand and girdle the stem. The stem portion

above the girdling canker dies and as the canker continues to advance down the stem, it kills more of the tree's crown (Boyce 1948). The rust disease prevents the tree from producing seed by destroying the top of the tree (Keane et al. 1994) and may also predispose the infected trees to other pathogens or damaging insects (Krebill and Hoff 1995).

White pine blister rust disease was introduced in the Northwest in the early 1900's and was first seen in Wyoming in 1945 at Yellowstone National Park (Brown and Graham 1969). Several limber pine sites were surveyed in the Bighorn and Medicine Bow National Forests for this disease in the 1960's and the disease incidence was described as low with only 6% of the trees infected (Brown and Graham 1969, Brown 1978). By aging the tree cankers produced by the disease, Brown (1978) estimated that the disease had been present on these sites for 30+ years in the Bighorn National Forest and 15+ years for the Medicine Bow National Forest.

Currently, white pine blister rust disease is most often found at low to moderate levels of infection in limber pine stands east of the Continental Divide in Wyoming (Brown 1978, Lundquist *et al.* 1992, Draper and Walla 1993, Kendall and Schirokauer 1997). These low infection levels may be due in part to the drier climate conditions caused by the rain shadow effect east of the Continental Divide. However, the rust fungus has proven to have a great ability to genetically adapt to various microclimates perhaps because of the five spore stages in its life cycle (Hoff and McDonald 1993). In addition, wind patterns along drainages may concentrate dispersal of fungal spores to host plants causing an increase in the incidence and severity of the disease in those forested areas (Brown 1978). Surveys for white pine blister rust disease west of the Continental Divide found increased incidence levels on the Targhee and Bridger-Teton National Forests in Wyoming (Smith and Hoffman 1998).

USDA Forest Service, Rocky Mountain Region, Forest Health Management (FHM) recognized the destructive potential of this disease to limber pine and surveyed several stands on the Bighorn and Medicine Bow National Forests in 1996. Permanent plots for long term monitoring of white pine blister rust disease were established on several of these sites in 1997 and 1998. Evaluations of the white pine blister rust disease incidences were made for the survey and permanent plots sites of the Bighorn and Medicine Bow National Forests. Descriptions of other data elements of the permanent plots are provided.

Methods

Survey and permanent plot sites were selected in areas where white pine blister rust disease occurred (Brown 1967) to evaluate if the disease was still present and had increased in incidence or severity (Figure 1). Sites and plots were named according to nearby landmarks and the locations are listed in Table 1. Methods for the survey and the installation of permanent plots were different. However, tree growth data and white pine blister rust disease data were collected using similar methods for both the survey sites and permanent plots.

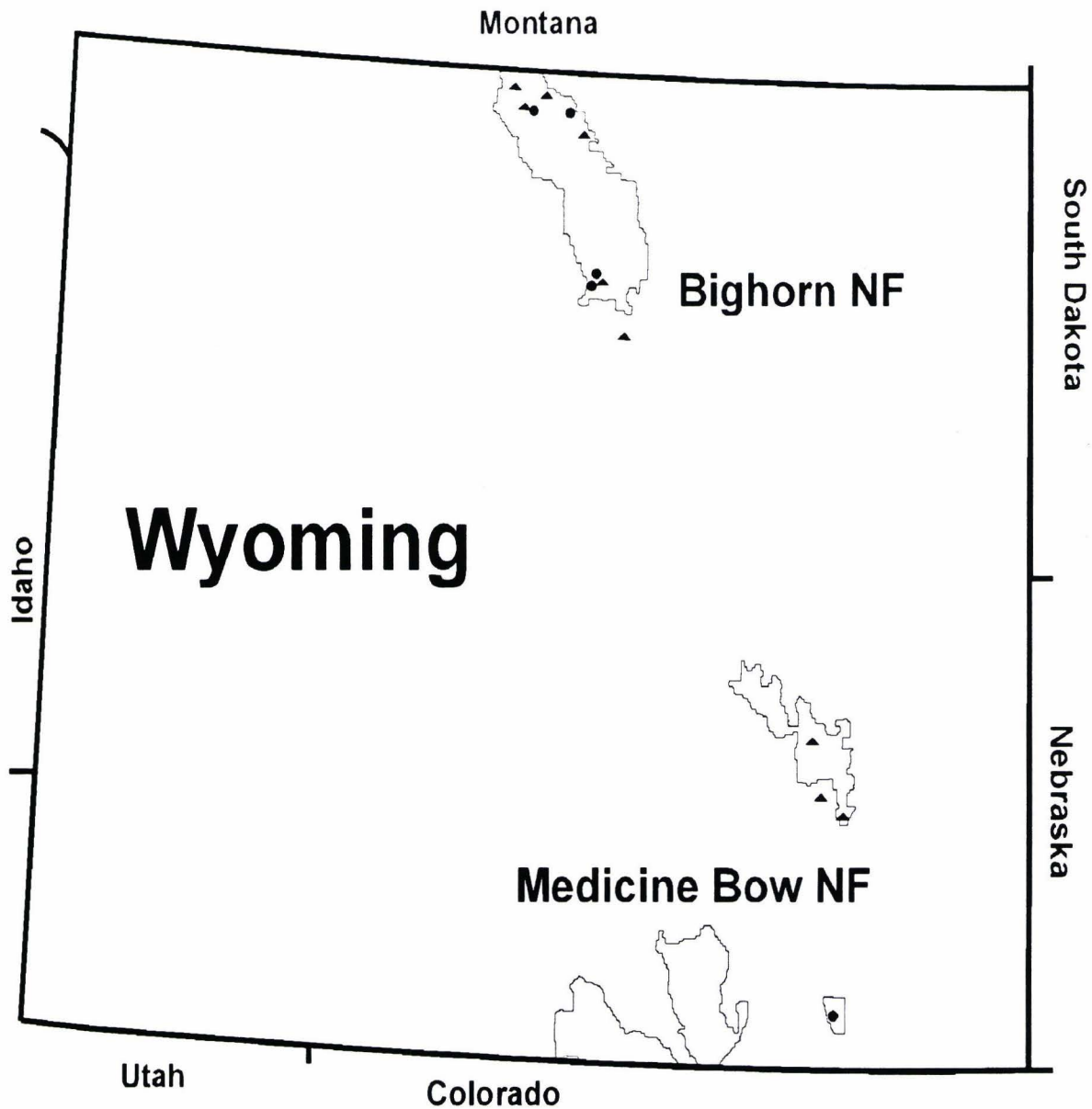


Figure 1. Incidence of White Pine Blister Rust (wpbr) Disease in limber pine forest stands of the Bighorn and Medicine Bow National Forests (NF). Survey sites and permanent plots (●) were evaluated for white pine blister rust from 1996 to 1998. Previously, white pine blister rust was found at several survey sites (▲) on or near these forests (Brown 1967, Brown 1978).

Table 1. Names and locations of the survey sites and permanent plots on the Bighorn and Medicine Bow National Forests in Wyoming. Sites and permanent plots were named for nearby landmarks of the area.

Survey sites (ss) and Permanent plots (pp)	General locations by Townships, Ranges, and Sections
Bighorn - Shell Canyon (ss)	56N. 91W. Sec. 20, 29
Bighorn - Lake Creek (pp)	56N. 89W. Sec. 14
Bighorn - Turkey Creek (pp)	56N. 87W. Sec. 21
Bighorn - Ten Sleep Canyon (ss)	48N. 88W. Sec. 33
Bighorn - Ten Sleep Canyon (pp)	48N. 87W. Sec. 19
Bighorn - Ten Sleep Canyon (pp)	48N. 87W. Sec. 26
Medicine Bow - Pole Mtn. (pp)	15N. 72W. Sec. 14
Medicine Bow - Pole Mtn. (pp)	15N. 72W. Sec. 27
Medicine Bow - Pole Mtn. (ss)	14N. 71W. Sec. 20, 29

Survey

Chain-wide transects were traversed for at most 10 chains or 100 host trees at each survey site. Only limber pine with stems larger than 4" dbh were evaluated and many were found growing in shrublike groups. Each stem was recorded as a separate tree and noted if it was growing in a group with other stems.

Tree data were collected for species, diameter at breast height (dbh), crown class, crown ratio, and tree heights. Health status of the tree was evaluated as:

- "healthy" for no signs/symptoms of damage,
- "declining" for one to three incidences of damage,
- "dying" for four or more damages,
- "dead due to the rust", or
- "dead due to other factors".

Other damaging agents of the tree were noted and increment cores were taken on every tenth tree to determine age.

Rust damages were assessed by evaluating visible cankers. Canker heights and percent girdling were recorded for each stem canker. Heights of branches with girdling cankers within three feet of the stem were noted. The number of branch cankers beyond three feet of the stem were counted for each tree.

Permanent Plots

The permanent plots were fixed radius, 1/10 acre, circular plots; two of the plots were only 1/20 acre due to site constraints. Reference point trees were marked near the road and along hiking trails according to local forest managers' instructions. The plot centers were marked with an orange, hooked, rebar metal stake. All "plot" trees had a dbh of at least 4 inches; trees with a dbh less than 4 inches were classified as regeneration. Plot trees were tagged with a numbered, metal tag at dbh level facing towards plot center. Health status, rust damages, and tree growth data were recorded for each tree as described above in the survey. Other damaging agents of the trees were recorded. Tree ages and site indices were evaluated for three trees of each species on the plot.

Regeneration was recorded for each plot with the use of three, 1/300 acre, circular subplots. Seedlings (trees less than 4.5 feet tall) were evaluated for species, height, and rust damages on the pines. Saplings (trees with a dbh between 0.1 - 3.9 inches) were recorded by species, dbh, height, and rust damages. Saplings were wired with a numbered, metal tag that will become their tree number as they increase in diameter and "grow into the plot."

Samples of understory vegetation and *Ribes* plants were collected from the plots and identified to genus and species. This identification of understory vegetation will be useful in determining habitat types. Species, percent ground cover, and average heights were recorded for each *Ribes* spp. on the plot. Unfortunately, the permanent plots have not been revisited during the season when rust infection of the *Ribes* plants could be observed. Hopefully, future work on the plots by FHM will provide information about the rust infection of *Ribes* spp. in the area.

Data from all the host trees of both the survey and permanent plot sites were analyzed. Each host tree was categorized for rust severity according to its most serious rust sign/symptom. The rust severity categories were:

- no rust disease,
- multiple branch cankers,
- non-girdling stem cankers,
- girdling stem cankers, and
- mortality due to the rust.

Results and Discussion

Low to moderate incidence levels of white pine blister rust disease were found on the Bighorn and Medicine Bow National Forests. The percent infection and rust disease severity levels of each site are presented in Table 2.

Table 2. Percent infected limber pine trees of the survey sites and permanent plots on the Bighorn and Medicine Bow National Forests in Wyoming. Bighorn NF - Northern sites were the Shell Canyon, Lake Creek, and Turkey Creek sites described in Table 1. Severity of infections: 1 = branch cankers within 6" of the stem, 2 = non-girdling stem cankers, 3 = 100% girdling stem cankers causing topkill.

	Number of limber pine examined	Percent Infected	Number of Trees with Severity 1 infections	Number of Trees with Severity 2 infection	Number of Trees with Severity 3 infection
Bighorn NF - Northern sites	104	18%	14	2	3
Bighorn NF - Ten Sleep Canyon	98	66%	16	18	31
Medicine Bow NF - Pole Mountain	105	50%	29	17	7

The three sites in the northern area of the Bighorn National Forest (Shell Canyon, Lake Creek, and Turkey Creek) had very little rust infection. The disease incidence occurred on scattered trees with only a few trees containing girdling stem cankers. Brown (1978) reported that the disease in the Turkey Creek area may be epidemic and intensifying as it spreads through limber pine stands in the northern portions of the Bighorn National Forest. This recent survey and evaluation of permanent plots indicates that this disease is still at low infection levels and has not significantly increased on these sites.

The low incidence levels in the northern Bighorn sites were in sharp contrast to the higher levels of infection in the Ten Sleep Canyon sites along the southern area of the Bighorn National Forest. Several trees were found declining and dying from the disease in Ten Sleep Canyon during this survey and evaluation. The rust caused numerous branch cankers and topkill to a large percentage of the surveyed trees. Perhaps rust-caused mortality will be seen in future remeasurements of the permanent plots.

Brown (1978) did not survey Ten Sleep Canyon but he did survey lands managed by the Bureau of Land Management just south of Ten Sleep Canyon. Brown indicated that the disease seemed to just becoming established in the area. FHM entomologist Judy Pasek noted in a site visit report (1990) of Ten Sleep Canyon that there appeared to be increasing damage by the disease in the area. FHM found 66% of the limber pine in Ten Sleep Canyon to be infected with white pine blister rust disease during this survey and evaluation.

The Pole Mountain area of the Medicine Bow National Forest had a moderate level of the disease with 50% of the limber pine infected. The alternate host plants, *Ribes* spp., were not found on the plots in the Pole Mountain area; however, *Ribes* plants are abundant in the area and the disease has been able to become well-established on these sites. Brown (1978) reported that the disease appeared to just be starting in the Laramie Peak area of the Medicine Bow National Forest even with the nearest infections occurring many miles away from Laramie Peak. Apparently, wind patterns have allowed the fungal spores to travel and become established in the Pole Mountain area. The spread of *C. ribicola* to Southern Wyoming may be similar to the recent spread of the fungus into Northern Colorado forests (Johnson 1999).

Six to seven percent vegetative ground covers of *Ribes lacustre*, *R. odoratum*, and *R. cereum* were found on the Bighorn National Forest sites and plots. No *Ribes* spp. were found on the sites nor permanent plots of the Medicine Bow National Forest.

Although white pine blister rust disease levels are currently low to moderate on the Bighorn and Medicine Bow National Forests, FHM should continue to monitor these permanent plots for changes in the incidence and severity levels of these sites. If infection levels become unacceptable to forest managers then perhaps suppression efforts could be used to reduce the disease incidence in these areas. Thinning limber pine stands to reduce susceptibility to mountain pine beetle (*Dendroctonus ponderosae*) or hazard tree removal in recreational areas may assist in reducing white pine blister rust infection at these sites. This may also help mitigate some of the harsh conditions of limber pine sites and promote improved tree growth and resistance or tolerance of white pine blister rust disease.

References

- Boyce, J.S. 1948. Stem disease: rusts of conifers. Forest Pathology, 2nd ed. McGraw-Hill Book Company, Inc. New York, Toronto, London: 206-209.
- Brown, D.H. and Graham, D.A. 1969. White pine blister rust survey in Wyoming, Idaho, and Utah: 1967. USDA Forest Service, Northern Region, State and Private Forestry Report. 11 pp.
- Brown, D.H. 1967. White pine blister rust survey in Montana and Wyoming 1966. USDA Forest Service Northern Region, Missoula, MT. 11p.
- Brown, D.H. 1978. The status of white pine blister rust on limber pine and whitebark pine in Wyoming. USDA Forest Service, Rocky Mountain Region, Tech. Report: R2-13.
- Draper, M.A. and Walla, J.A. 1993. First report of *Cronartium ribicola* in North Dakota. Plant Dis. 77 (9): 952.
- Hoff, R.J.; Hagle, S.K.; and Krebill, R.G. 1992. Genetic consequences and research challenges of blister rust in whitebark pine forests. Proc. of International Workshop on Subalpine stone pines and their environment; St. Moritz, Switzerland, Sept. 5-11, 1992; p.118-126.

- Hoff, R.J. and McDonald, G.I. 1993. Variation of virulence of white pine blister rust. *Eur. J. For. Path.* 23:103-109.
- Hoff, R.; Bingham, R.T.; and McDonald, G.I. 1980. Relative blister rust resistance of white pines. *Eur. J. For. Path.* 10: 307-316.
- Johnson, D.W. 1999. Service Trip Report, White Pine Blister Rust Survey. USDA Forest Service, Region 2 Forest Health Management, LSC-99-07.
- Keane, R.E.; Morgan, P.; and Menakis, J.P. 1994. Landscape assessment of the decline of whitebark pine (*Pinus albicaulis*) in the Bob Marshall Wilderness Complex. Montana, USA. *Northwest Science* 68 (3) 213-229.
- Kendall, K.C. and Schirokauer, D. 1997. Alien threats and restoration dilemmas in whitebark and limber pine communities. *Proc. of the 9th Conference on Research and Resource Management in Parks and on Public Lands*. Albuquerque, NM. March 17-21, 1997. Ed. D. Harmon. p.218-225.
- Krebill, R.G. and Hoff, R.J. 1995. Update on *Cronartium ribicola* in *Pinus albicaulis* in the Rocky Mountains, USA. *Proc. 4th IUFRO Rusts of Pines, Working Party Conf.*, Tsukuba: 119-126.
- Lundquist, J.E.; Geils, B.W.; and Johnson, D.W. 1992. First report of white pine blister rust on limber pine in South Dakota. *Plant Dis.* 76:538.
- Pasek, J.E. 1990. Service Trip to Tensleep Ranger District. USDA Forest Service, Region 2 Forest Health Management, RCSC-90-7.
- Smith, J. and Hoffman, J. 1998. Status of white pine blister rust in Intermountain Region white pines. USDA Forest Service, Intermountain Region, Report No. R4-98-02.
- Taylor, J.E. and Schwandt, J.W. 1998. *Dothistroma* needle blight on limber pine in Montana. USDA Forest Service, Northern Region, Rep. 98-4.